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Seed germination ecology and sapling establishment features of *Pterocarpus santalinus* - an endemic and dominant tree in dry deciduous forests of hill ranges in Kadapa region of Sheshachalam Biosphere Reserve

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Pterocarpus santalinus (L.) belongs to family Fabaceae that occurs as the predominant tree species both in terms of density and biomass in hill ranges of seshachalam Biosphere Reserve in southern Eastern Ghats (Ankalaiah et al., 2017). In this communication we will try to provide a perspective to understand the seed germination ecology and strategies employed for sapling establishment by *Pterocarpus santalinus* (Red sanders) to occur as dominant tree in the forest based on field notes and observations.

Red sanders produce fruits (pods) that are obliquely orbicular in shape with an average horizontal length of 44.32 mm and a vertical length of 37.54 mm and consists of wing like sheath surrounding the pods with a pedicel length of 22.94 mm. The average weight of matured dried fruits collected from the tree is 1.11 – 1.29 g and the seeds are in reddish brown color with an average weight of 0.198 – 0.22 g and 1.0 – 1.5 mm long. The screening of 1000 pods revealed that 684 (68.4%) pods comprise of two locules filled with only one seed followed by pods with 2 locules filled with one seed in each locule (16.3%), (5.6%) of pods were with three locules but filled with only one seed (Ankalaiah and Reddy 2017; Image:1). It indicates that Red sanders abort one seed for better dispersal. Further, Red sanders belong to a group of dry forest tree species that disperse matured seeds in the dry season but tend to synchronise the seed germination with favourable wet season. This is achieved by producing seeds showing physical dormancy by producing tough fibrous pod (pericarp) enclosing the seeds. While the features like dispersal during windy dry season, having pods with circular wing, seeds of relatively smaller size and lower weight helps for better dispersal to fall in the favourable microsites. The dispersed and fallen seeds dormancy is usually

broken by extreme temperatures and sometimes by fire that usually occur in the dry season. By which, once the wet rainy season and desirable soil moisture available, the seeds will germinate. If not these pods after losing the pedicle and wing will become part of the soil seed bank.



Image 1: A) Fruit bud at 10days stage. B) Pod explanation (45 days). C) Dried pod (245 days). D) Majority of pods are with 2 locules filled with one seed. E) Rare feature of two locules filled with two seeds. F) Seed germination.

A total of 720 pods were collected from Kadapa hill ranges and seed germination for a period of 12 months having a batch of 60 seeds in each month with an interval of one month were recorded. Germination percentage of 28% (range of 10-35%) was observed up to six months and later it got reduced to 13.3% (9-18%). The tetrazolium chloride seed viability test revealed high viability (66%) which has decreased to 23% after one year when the pods are stored under normal laboratory conditions. The presence of high seed

viability rate but varied germination rate when pods are germinated indicates that hard pericarp structure around the pod cause physical constraint for seed germination. The pericarp induced seed physical dormancy may help the Red sanders to prevail over the germination due to occasional drizzle rains in the pre-monsoon period. Further, as seed viability is found after 10-12 months also, the chance of rotation between dormant to non-dormant seed stages would also be found in the life cycle of Red sanders. In the forest we found few trees were found to have persistent dried pods hanging throughout the dry period indicating that serotiny feature is also present among the Red sanders.



Image 2: Red sanders Seedlings/Saplings showing well grown taproot featuring suffrutex stage



Image 3: A: Seedling with multiple sprouts and B: Tap root revealing higher root biomass

Once seedlings got established in the season of that particular year, these sprouts try to accumulate more root biomass than height in the incoming years (Image 2). Further these are found to be with multiple stems due to die-back of stems by fire and later grown from the root collar as sprouts. The root stock will be well developed and that particular seedling age will be greater than the current growing stem of this season in age (Image 3). This kind of survival to overcome ground fires by suffrutex stage can be authenticated by the presence of multiple shoots. Such kind of regenerative strategy of re sprouting after fire was reported in *Burkia africana* (Wilson and Witkowski 2003) and *Pterocarpus angolensis* (Banda et al., 2006) in African dry forests. Among the total seedlings (plants up to 40 cm height) recorded in the 20 (1-ha) study sites, overall 60% of seedlings were with multiple stems and rest 40% were with single stem. Further categorization indicate that, (30.6%) of seedlings were with two stems, 16.7% of seedlings possessed three stems and 12.9% seedlings were with >3 stems. The multiple sprouts strategy can be thought of a mechanism to produce above ground shoots after a disturbance like fire and browsing. The cycle of death and resprouting several times for few years may be advantageous as in this duration the roots will be well established and will be in a position to extract water and nutrients from even deeper soils.

Conclusions

The results on seed germination suggest that the timing of seed germination and establishment of seedling and growing into sapling through resprouting enables Red sanders to be competitive among the trees at establishment stages and also become dominant in these dry forests. The regeneration survey indicates that, Red sanders has the capacity to resprout by forming sprouts (suffrutex stage) if any damages occur to seedlings by fire which occurs naturally in these dry deciduous forests. Thus, formation of seedlings of multiple years in the form of suffrutices is the survival strategy featured by Red sanders in addition to the seed bank formation.

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Ethical approval

Pterocarpus santalinus from dry deciduous forests of hill ranges in Kadapa region of Sheshachalam Biosphere Reserve, India was observed in the study. The ethical guidelines for plants & plant materials are followed in the study for sample collection & identification.

Conflicts of interests

The authors declare that there are no conflicts of interests.

Data and materials availability

All data associated with this study are present in the paper.

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